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PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Processes for the Treatment of Plant Materials in the Preparation of Fibres.

We, THE ABBEY SYNDICATE LIMITED, a British company, of 11, Waterloo Place, London, S.W. 1, and DINSHAW RATTONJI NANJI, D.Sc., F.I.C., of 64, Arden Road, Birchfields, Birmingham, British subject, do hereby declare the nature of this invention to be as follows:—

This invention comprises a new or improved process for separating the individual component fibres of fibrous plant tissues and like materials, and also for the production directly from plant tissues of fibres suitable for spinning and for other purposes.

The fibres in the tissues of plants, such as for example flax, hemp, sisel, ramie and bamboo, are cemented together by pectinous, gummy and like substances.

Ordinarily, the fibres of flax and similar plants may be loosened and separated by a fermentation process technically known as retting, which results in the conversion of insoluble pectinous binding bodies into soluble pectin and its derivatives which can be removed from the fibres by pressing and washing.

The retting process is open to objection on account of its being extremely lengthy to carry out, a period of treatment up to ten days being generally necessary. The process requires careful control and is particularly subject to the deleterious effect of adverse weather conditions. Again a full yield is never obtained because of the considerable loss incurred in the scutching operations. The yield is never more than 50% of the fibre content of the raw material. In order to overcome these disadvantages chemical retting or resolving processes have been proposed, making use of such varied reagents as acids, benzine, carbon tetrachloride or ethyl trichloride. Chemical processes on these lines have not, however, hitherto met with any marked degree of success.

The object of the present invention is an improved process for the treatment of the fibrous tissues, whereby the fibres are separated from one another expeditiously, and the enveloping pectinous and like binding bodies are converted into a soluble and/or easily removable condition after a short time of treatment.

[*Price* 1/-]

The improved process essentially consists in submitting the raw fibrous materials to the action of a chemical reagent, capable of undergoing ionic exchange with the insoluble pectinous complexes and gums, constituting the binding medium. Compounds of the alkali metals or of ammonium capable of undergoing ionization in aqueous solution can be employed in this process, and it is preferable to make use of neutral salts of the aforementioned bases such as the tartrates, oxalates, citrates, sulphates and phosphates.

Not only does the use of the neutral salts lead to no deterioration of the fibres even when the process is carried out at comparatively high pressures, but it will be observed that the anions of these compounds form sparingly soluble combinations with the alkaline earth metals with which the pectinous substances are associated, thus rendering more certain the efficiency of the ionic exchange in accordance with the accepted physico-chemical theory of mass-action.

The depectinizing process in accordance with the present invention also serves as the basis of a new or improved process of treating ramie and like fibrous plant tissues for the production of fibres suitable for spinning.

Although ramie is one of the strongest and finest of natural fibres known, it has hitherto not been possible to prepare the fibre economically owing to the difficulties met with in its isolation. Ramie grass contains an excessive amount of pectic substances and gums which are very difficult to remove by the ordinary retting processes, without deteriorating the quality of the fibre.

Further, in order to carry out the retting or mechanical processes, it is desirable that the grass should be treated in a comparatively fresh condition, as the pectic and gummy substances binding the fibres harden as the grasses dry, and offer greater difficulty to separation. Also the ribbons of grass have to be separated mechanically from the stalk and prepared for retting or mechanical process prior to the isolation of the fibres neces-

sitating a considerable amount of labour. Again there is considerable wastage involved in the separation of the fibre by existing methods which may amount to as much as 50% of the theoretical fibre content.

A further object of the present invention therefore is to avoid the above difficulties and to produce a fibre of superior spinning quality directly from the ramie or like tissues, effecting considerable economies in labour and time, and obtaining a greatly improved yield of fibre.

After a preliminary depectinizing of the tissue by means of a reagent capable of undergoing ionic exchange with the insoluble pectinous complexes and gums which are rendered soluble and rapidly removed thereby the tissue is heated with a suitable alkaline solution under pressures much higher than hitherto employed in alkali treatments, namely about ten atmospheres, for a short time, for example, twenty to sixty minutes, or the heating may be carried out at temperatures corresponding to such high pressures.

This additional step is rendered necessary in the cases of ramie and allied fibres owing to the presence of substances such as fats, waxes, cutaneous substances and resins impregnating or adhering to the fibres.

The ramie tissue also contains colouring matter—notably chlorophyl—which persists even after the above alkali treatment, so that we prefer to bleach the fibres in any suitable and known manner subsequent to that treatment. The previous processes for depectinizing, and purification under high pressure with alkali, facilitate bleaching processes, and give a product which does not require any mechanical separation, as the ultimate fibres are directly obtained. We may in some circumstances repeat the alkaline treatment of the fibres after bleaching but in this case the duration of treatment may be shorter.

We are aware that it has been known to employ an alkaline reagent in the treatment of fibres; but if such is employed before depectinising, the result is to produce dark coloured substances and impurities which are absorbed by the fibres or are deposited between them. Such impurities militate against bleaching as they form insoluble substances necessitating a more severe bleaching treatment, and giving a poor appearance to the bleached fibre.

The process as outlined for the treatment of ramie requires a slight modification when applied to the treatment of bamboo with a view to its utilisation for the production of useful fibres, capable of being spun and employed for ropes, sacking, and a number of other purposes.

We have found that bamboo is not amenable to treatment by the full process, as its fibres are rendered brittle and short if subjected to the full alkaline treatment. But if the tissues are depectinized and then submitted to alkali treatment, e.g., in an autoclave until the pressure rises to from seven to ten atmospheres at which it may remain under treatment for a very short time, the individual fibres are found to be separated one from the other quite satisfactorily, and at the same time, owing to the lignified tissue connecting the ultimate fibres being unaffected, the length of the main fibres is unchanged by the treatment and any tendency to brittleness is overcome. The following are examples of the way in which the invention may be applied in practice, giving typical working conditions of temperature, pressure and time of treatment.

A preliminary example gives details of the application of the invention to flax straw. Unretted flax straw is heated with a suitable quantity of 0.1 to 0.5 per cent. of ammonium sulphate solution under a pressure of 1 to 2 atmospheres or at temperatures corresponding to these pressures for a period of from 60 down to 20 minutes. During this time the insoluble pectose which binds the fibre together is converted to soluble pectin without the fibre being deleteriously affected, and upon the completion of this operation pressure is applied to the fibre or straw to express and remove the adhering slimy matter, and subsequently the fibre or straw is washed in water and dried, the flax being then obtained from the straw in the ordinary manner, such as by scutching, hackling and combing.

In this way a very considerable saving in time is effected, leading to a consequential diminution in the cost of producing the flax.

The reagent is preferably employed for treating several batches of raw material and can be used until its colour becomes too dark, and staining of the fibre occurs. Natural acids derived from the materials are liberated during treatment and are found to have a favourable effect on the quality of fibre produced.

After becoming valueless for further use in the process the waste liquors consisting in the above example of dilute solutions of ammonium sulphate are available for manuring purposes.

As a working example of the process as applied to treatment of ramie and like grasses, the following is typical.

The unretted straw or grasses may be

heated with a suitable volume of 0.1 to 0.5 per cent. ammonium sulphate solution at a pressure of 1 to 2 atmospheres or at a coresponding temperature for a period of time of from between sixty and twenty minutes. This treatment of the ramie results in the conversion of the insoluble pectose substances into soluble pectin.

When this conversion of the pectose substances into the soluble pectin has been effected the fibrous mass is removed and pressed to eliminate the slimy matter adhering to the fibres. The unworked fibres are placed in an autoclave and heated with a solution of 2—4% caustic soda at a pressure of 10 atmospheres or thereabouts for a period of between twenty and sixty minutes. At the expiration of the required time the fibres are removed from the autoclave and washed and dried, the resultant product being found to have a lustrous, silky appearance and texture, the appearance being comparable to that of the lustrous cellulose products known to commerce as "artificial silk" but in addition the material prepared in accordance with this invention is of a much greater tensile strength than the filaments of the products known as "artificial silk". Furthermore, the lustrous material can be produced at a relatively low cost compared with ordinary artificial silk since abundant and cheap supplies of ramie are available and the plant can be extensively cultivated.

In view of the superiority of ramie fibre to cotton, and the very much larger yield of the fibre per acre, it may be economically possible to replace much of the cotton at present used with ramie treated as above set forth.

The following example gives working particulars of the process as applied to bamboo.

The bamboo for purpose of depectinizing is first cut to convenient length and thickness, and heated, as set forth in our said earlier application, preferably with very dilute solutions of neutral salts of the alkali metals or ammonium. 0.1 to 0.5% ammonium sulphate may conveniently be employed at a pressure of from 1 to 2 atmospheres or at temperatures corresponding to these pressures for a period of time between sixty and twenty minutes. This treatment separates the individual fibres. In order to render these fibres pliable and suited for spinning, the fats, waxes, cutaneous substances and resins contained therein are removed or destroyed by heating with alkaline solution, conveniently 2—4% caustic soda solution, in an autoclave until the pressure rises to from seven to ten atmospheres. When the pressure has reached this point, it is lowered again to normal, and the process is complete. The maximum pressure must not be maintained for any considerable period, and in a large scale practice wherein, say a ton of material is treated at a time, the period of treatment can be extended to as much as fifteen minutes or more. This special treatment with alkali has been found necessary on account of the fact that prolonged treatment with this reagent destroys the lignified connecting tissues between the ultimate fibres, so that the main fibres are readily broken and are very brittle.

A shortened treatment, as outlined, preserves this connecting tissue at the same time quite satisfactorily destroying the undesirable siliceous matter which encases the fibres.

In its greater length and strength lies a large proportion of the superiority of the bamboo fibre over those such as hemp, jute and the like previously used for rope and sack manufacture.

We have found that the outer layer or skin of the bamboo cane is not susceptible to the above treatment owing to its constitution being entirely different from that of the enclosed fibrous material. When the mass has, however, undergone the alkali treatment and whilst it is still moist, this husk or skin is softened and may be readily detached from the fibre and removed.

If the mass is allowed to dry before this removal, the husk is hardened and difficulty is experienced owing to the tenacity with which adjacent fibres are held to it.

Owing to the colour of the bamboo fibre and the uses to which it is likely to be subjected there is little necessity for any bleaching process subsequent to the alkali treatment. If desired, however, the fibre may be bleached in known manner although this may occasion mechanical weakening.

Dated this 1st day of April, 1927.

For the Applicants,
GEORGE BARKER & BRETTELL,
Chartered Patent Agents,
75 & 77, Colmore Row, Birmingham.

COMPLETE SPECIFICATION.

Processes for the Treatment of Plant Materials in the Preparation of Fibres.

We, THE ABBEY SYNDICATE LIMITED, a British company, of 11, Waterloo Place, London, S.W. 1, and DINSHAW RATTONJI NANJI, British subject, of 64, Arden Road, Birchfields, Birmingham, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention comprises a new or improved process for separating the individual component fibres of fibrous plant tissues and like materials, and also for the production directly from plant tissues of fibres suitable for spinning and for other purposes.

The fibres in the tissues of plants, such as for example flax, hemp, sisel, ramie and bamboo, are cemented together by pectinous, gummy and like substances.

Ordinarily, the fibres of flax and similar plants may be loosened and separated by a fermentation process technically known as retting, which results in the conversion of insoluble pectinous binding bodies into soluble pectin and its derivatives which can be removed from the fibres by pressing and washing.

The retting process is open to objection on account of its being extremely lengthy to carry out, a period of treatment up to ten days being generally necessary. The process requires careful control and is particularly subject to the deleterious effect of adverse weather conditions. Again a full yield is never obtained because of the considerable loss incurred in the scutching operations. The yield is never more than 50% of the fibre content of the raw material. In order to overcome these disadvantages chemical retting or resolving processes have been proposed, making use of such varied reagents as benzine, carbon tetrachloride or ethyl trichloride, alkaline substances, acids and salts of various kinds such as borax, acetate of soda, ammonium chloride and soap, basic salts of polyatomic acids, mixtures of sodium sulphate and sodium bicarbonate, alkali and alkaline earth sulphides with or without alum, and other compounds. Chemical processes on these lines have not however hitherto met with any marked degree of success. The proposed salts have been used at concentrations of from 2% upwards, so that even when a pressure of 50 to 55 pounds per square inch has been employed as in conjunction with sodium carbonate and other substances such as soap, at large concentrations or when the fibres have been treated with alkaline solutions at from 8—10 atmospheres pressure after a preliminary acid treatment, an efficient ionic exchange with the insoluble pectinous bodies as in the process covered by the present invention and as described in the sequel is precluded.

The object of the present invention is an improved process for the treatment of the fibrous tissues, whereby the fibres are separated from one another expeditiously, and the enveloping pectinous and like binding bodies are converted into a soluble and/or easily removable condition after a short time of treatment.

The improved process essentially consists in heating the raw fibrous materials with an aqueous solution of a neutral salt of one of the alkali metals or of ammonium, the concentration of the solution being from 0.1 to 0.5 per cent. At this concentration the ionization of the reagent is very high so that it is capable of undergoing ionic exchange with the insoluble pectinous complexes and gums constituting the binding medium to fullest advantage.

It is preferable to make use of those salts of the aforementioned bases whose anions are capable of precipitating from solution the alkaline earth metals with which the pectinous substances are associated, suitable salts being the tartrates, oxalates, citrates, sulphates and phosphates. This renders more certain the efficiency of the ionic exchange in accordance with the accepted physico-chemical theory of mass-action. The use of neutral salts leads to no deterioration of the fibres even when the process is carried out at comparatively high pressures.

The depectinizing process in accordance with the present invention also serves as the basis of a new or improved process of treating ramie and like fibrous plant tissues for the production of fibres suitable for spinning.

Although ramie is one the strongest and finest of natural fibres known, it has hitherto not been possible to prepare the fibre economically owing to the difficulties met with in its isolation. Ramie grass

contains an excessive amount of pectic substances and gums which are very difficult to remove by the ordinary retting processes, without deteriorating the quality of the fibre.

Further, in order to carry out the retting or mechanical processes, it is desirable that the grass should be treated in a comparatively fresh condition, as the pectic and gummy substances binding the fibres harden as the grasses dry, and offer greater difficulty to separation. Also the ribbons of grass have to be separated mechanically from the stalk and prepared for retting or mechanical process prior to the isolation of the fibres necessitating a considerable amount of labour. Again there is considerable wastage involved in the separation of the fibre by existing methods which may amount to as much as 50% of the theoretical fibre content.

A further object of the present invention therefore is to avoid the above difficulties and to produce a fibre of superior spinning quality directly from the ramie or like tissues, effecting considerable economies in labour and time and obtaining a greatly improved yield of fibre.

After a preliminary depectinizing of the tissue by means of a reagent capable of undergoing ionic exchange with the insoluble pectinous complexes and gums which are rendered soluble and rapidly removed thereby the tissue is heated with a suitable alkaline solution under pressures much higher than hitherto employed in alkali treatments, namely about six to ten atmospheres, for a short time, for example, twenty to sixty minutes, or the heating may be carried out at temperatures corresponding to such high pressures.

This additional step is rendered necessary in the cases of ramie and allied fibres owing to the presence of substances such as fats, waxes, cutaneous substances and resins impregnating or adhering to the fibres.

The ramie tissue also contains colouring matter—notably chlorophyl—which persists even after the above alkali treatment, so that we prefer to bleach the fibres in any suitable and known manner subsequent to that treatment. The previous processes for depectinizing, and purification under high pressure with alkali, facilitate bleaching processes, and give a product which does not require any mechanical separation, as the ultimate fibres are directly obtained. We may in such circumstances repeat the alkaline treatment of the fibres after bleaching, but in this case the duration of treatment may be shorter.

We are aware that it has been known to employ an alkaline reagent in the treatment of fibres; but if such is employed before depectinizing, the result is to produce dark coloured substances and impurities which are absorbed by the fibres or are deposited between them. Such impurities militate against bleaching as they form insoluble substances necessitating a more severe bleaching treatment, and giving a poor appearance to the bleached fibre.

The process as outlined for the treatment of ramie requires a slight modification when applied to the treatment of bamboo with a view to its utilisation for the production of useful fibres, capable of being spun and employed for ropes, sacking, and a number of other purposes.

We have found that bamboo is not amenable to treatment by the full process, as its fibres are rendered brittle and short if subjected to the full alkaline treatment. But if the tissues are depectinized and then submitted to alkali treatment, e.g., in an autoclave until the pressure rises to from seven to ten atmospheres at which it may remain under treatment for a very short time, the individual fibres are found to be separated one from the other quite satisfactorily, and at the same time, owing to the lignified tissue connecting the ultimate fibres being unaffected, the length of the main fibre is unchanged by the treatment and any tendency to brittleness is overcome. The following are examples of the way in which the invention may be applied in practice, giving typical working conditions of temperature, pressure and time of treatment.

A preliminary example gives details of the application of the invention to flax straw. Unretted flax straw is heated with a suitable quantity of 0.1 to 0.5 per cent. of ammonium sulphate solution under a pressure of 1 to 2 atmospheres or at temperatures corresponding to these pressures for a period of from 60 down to 20 minutes. During this time the insoluble pectose which binds the fibre together is converted to soluble pectin without the fibre being deleteriously affected, and upon the completion of this operation pressure is applied to the fibre or straw to express and remove the adhering slimy matter, and subsequently the fibre or straw is washed in water and dried, the flax being then obtained from the straw in the ordinary manner, such as by scutching, hackling and combing.

In this way a very considerable saving in time is effected, leading to a consequential diminution in the cost of producing the flax.

The reagent is preferably employed for

treating several batches of raw material and can be used until its colour becomes too dark, and staining of the fibre occurs. Natural acids derived from the materials are liberated during treatment and are found to have a favourable effect on the quality of fibre produced.

After becoming valueless for further use in the process the waste liquors consisting in the above example of dilute solutions of ammonium sulphate are available for manuring purposes.

As a working example of the process as applied to treatment of ramie and like grasses; the following is typical.

The unretted straw or grasses may be heated with a suitable volume of 0.1 to 0.5 per cent. ammonium sulphate solution at a pressure of 1 to 2 atmospheres or at a corresponding temperature for a period of time of from between sixty and twenty minutes. This treatment of the ramie results in the conversion of the insoluble pectose substances into soluble pectin.

When this conversion of the pectose substances into the soluble pectin has been effected the fibrous mass is removed and pressed to eliminate the slimy matter adhering to the fibres. The unworked fibres are placed in an autoclave and heated with a solution of 2—4% caustic soda at a pressure of from 6 to 10 atmospheres or thereabouts for a period of between twenty and sixty minutes. At the expiration of the required time the fibres are removed from the autoclave and washed and dried, the resultant product being found to have a lustrous, silky appearance and texture, the appearance being comparable to that of the lustrous cellulose products known to commerce as "artificial silk" but in addition the material prepared in accordance with this invention is of a much greater tensile strength than the filaments of the products known as "artificial silk". Furthermore, the lustrous material can be produced at a relatively low cost compared with ordinary artificial silk since abundant and cheap supplies of ramie are available and the plant can be extensively cultivated.

In view of the superiority of ramie fibre to cotton, and the very much larger yield of the fibre per acre, it may be economically possible to replace much of the cotton at present used with ramie treated as above set forth.

The following example gives working particulars of the process as applied to bamboo.

The bamboo for purpose of depectinizing is first cut to convenient length and thickness, and heated as previously set forth, preferably with very dilute solutions of neutral salts of the alkali metals or ammonium. 0.1 to 0.5% ammonium sulphate may conveniently be employed at a pressure of from 1 to 2 atmospheres or at temperatures corresponding to these pressures for a period of time between sixty and twenty minutes. This treatment separates the individual fibres. In order to render these fibres pliable and suited for spinning, the fats, waxes, cutaneous substances and resins contained therein are removed or destroyed by heating with alkaline solution, conveniently 2—4% caustic soda solution, in an autoclave until the pressure rises to from seven to ten atmospheres. When the pressure has reached this point, it is lowered again to normal, and the process is complete. The maximum pressure must not be maintained for any considerable period, and in large scale practice wherein, say a ton of material is treated at a time, the period of treatment can be extended to as much as fifteen minutes or more. This special treatment with alkali has been found necessary on account of the fact that prolonged treatment with this reagent destroys the lignified connecting tissues between the ultimate fibres, so that the main fibres are readily broken and are very brittle.

A shortened treatment, as outlined, preserves this connecting tissue at the same time quite satisfactorily destroying the undesirable siliceous matter which encases the fibres.

In its greater length and strength lies a large proportion of the superiority of the bamboo fibre over those such as hemp, jute and the like previously used for rope and sack manufacture.

We have found that the outer layer or skin of the bamboo cane is not susceptible to the above treatment owing to its constitution being entirely different from that of the enclosed fibrous material. When the mass has, however, undergone the alkali treatment and whilst it is still moist, this husk or skin is softened and may be readily detached from the fibre and removed.

If the mass is allowed to dry before this removal, the husk is hardened and difficulty is experienced owing to the tenacity with which adjacent fibres are held to it.

Owing to the colour of the bamboo fibre and the uses to which it is likely to be subjected there is little necessity for any bleaching process subsequent to the alkali treatment. If desired, however, the fibre may be bleached in known manner although this may occasion mechanical weakening.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A new or improved process for separating the individual component fibres of plant tissues, consisting in the heating of the raw material with a 0.1 to 0.5 per cent. aqueous solution of a neutral salt of one of the alkali metals or of ammonium.

2. A new or improved process for separating the component fibres of fibrous plant tissues, consisting in the heating of the raw material with a 0.1 to 0.5 per cent. aqueous solution of a neutral salt of one of the alkali metals, or of ammonium, the salt being one whose anion is capable of precipitating from solution a metal of the alkaline earth group.

3. A new or improved process, whereby unretted flax straw is heated with a suitable quantity of 0.1 to 0.5 per cent. ammonium sulphate solution under a pressure of from 1 to 2 atmospheres or at a corresponding temperature for a period of from 60 down to 20 minutes, after the completion of which operation pressure is applied to the mass to remove the slimy matter, and subsequently the fibre is washed, dried, and obtained from the straw by a scutching or similar process in the ordinary way.

4. A new or improved process of fibre production from ramie and like fibrous plant tissues by acting upon the tissue with a 0.1 to 0.5 per cent. solution of a neutral salt of one of the alkali metals or of ammonium so as to render soluble the insoluble pectinous complexes and gums constituting the binding material and subsequently heating the depectinized tissue with a suitable alkaline solution under high pressures, viz. from six to ten atmospheres or at temperatures corresponding to these pressures.

5. A new or improved process of fibre production from ramie, and like fibrous plant tissues by acting upon the tissue with solutions of neutral salts of the alkali metals or of ammonia of concentrations 0.1 to 0.5 per cent., and subsequently heating the depectinized tissue with a 2—4% solution of caustic soda at a pressure of from 6 to 10 atmospheres or thereabouts or at a corresponding temperature.

6. A new or improved process of fibre production from ramie and like fibrous plant tissues in which the unretted straw or grasses are heated with a suitable volume of 0.1 to 0.5 per cent. ammonium sulphate solution at a pressure of from 1 to 2 atmospheres for a period of time of from between sixty and twenty minutes, the fibrous mass is pressed to remove the slimy matter adhering to the fibres, and the unworked fibres are heated with a 2—4% solution of caustic soda at a pressure of from 6 to 10 atmospheres or thereabouts for a period of time between twenty and sixty minutes.

7. A process as claimed in any of Claims 4, 5 or 6 in which the fibres are bleached after the alkali treatment to remove the discolouration due to matters, such as chlorophyl present in the tissue.

8. The new or improved lustrous fibre suitable for spinning obtained by the processes claimed in any of Claims 4, 5, 6 or 7.

9. A new or improved process of treating bamboo for the production of fibre in which the raw material is treated with a 0.1 to 0.5 per cent. solution of a neutral salt of one of the alkali metals or of ammonium so as to render soluble the insoluble pectinous complexes and gums binding together the individual fibres and subsequently the depectinized fibres are heated with alkaline solution in a closed vessel until the pressure rises to from seven to ten atmospheres, and having attained this magnitude is lowered again to normal.

10. A new or improved process of treating bamboo for the production of fibre in which the raw material is heated with a 0.1 to 0.5 per cent. solution of a neutral salt of one of the alkali metals or of ammonium, as for example, a 0.1 to 0.5% solution of ammonium sulphate at a pressure of from 1 to 2 atmospheres, or at corresponding temperatures for a period of time between sixty and twenty minutes, and subsequently the depectinized fibres are heated with a 2—4% caustic soda solution in an autoclave until the pressure rises to from seven to ten atmospheres and having reached this point is lowered again to normal.

11. A process as claimed in either of Claims 9 or 10 in which when the mass has undergone the alkali treatment, and whilst it is still moist, the husk or skin in its softened condition is detached from the fibre and removed.

12. The improved fibre as obtained from bamboo by the process as claimed in any of Claims 9, 10 or 11.

13. The improved processes for resolving fibrous plant tissues into the component fibres, substantially as described.

Dated this 20th day of January, 1928.
For the Applicants,
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